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ABSTRACT
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using as a case study Allegheny County, Pennsylvania. The analysis includes
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children. (Contains 44 references.) (SM)

# Medicaid, Census, and the CPS:
## What They Reveal about Child Undercount and Poverty

by

Beth Osborne Daponte, Ph.D.
H. John Heinz III School of Public Policy and Management
Carnegie Mellon University
Pittsburgh, Pennsylvania 15213

and

Lara J. Wolfson, Ph.D.
Department of Statistics
Brigham Young University
Provo, Utah 84602

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# Medicaid, Census, and the CPS:

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## Abstract

"Medicaid Undercount" occurs when the number of people enrolled in exceeds the number estimated to be eligible for the program. One hypothesis proposed for this phenomenon has been inadequacies in the estimation of the number eligible for benefits, including health insurance status reporting error. We present a methodology for calculating the number of Medicaid-eligible children by combining multiple sources of data and use as a case study Allegheny County, Pennsylvania. The analysis includes adjustments for undercount and uncertainty about the population size and income distribution. Still, we find that for most age categories and income levels, the number of children enrolled exceeds the estimated eligible population. We discuss three possible explanations for this apparent over-enrollment, and speculate on the likelihood of severe census undercount of America's poorest children.

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# Medicaid, Census, and the CPS:
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## I. INTRODUCTION

A pressing economic and social policy problem facing the United States is the numbers of children who either lack or have inadequate health insurance. Under and un-insured children tend not to receive health care when they need it (United States General Accounting Office (US GAO) 1996, p. 4; Avruch et al 1998, p.445); and regular high quality health care is needed to ensure that children receive regular and required vaccinations, to ascertain if children are living in suitable environmental conditions, to check for age-appropriate growth and development, and detect diseases and abnormalities early. Neglect of health-related issues in early childhood can have long-reaching implications on the long-term health, survival, and quality of life of an individual, for which they may never be able to compensate. In spite of programs that target poor children, such as Medicaid and the State Children's Health Insurance Program (SCHIP), official estimates state that approximately 12.6% of American children had no health insurance at all in 1999 (Nelson and Mills 2001, Table 1).

One approach to increasing the proportion of poor children insured is to assure that every child eligible for health insurance through the Medicaid program participates in the program. Summer, Parrott, and Mann (1997) write that if all Medicaid (income) eligible children had enrolled in the program, then "the number of uninsured children under age 11 would have been reduced by as much as 45 percent." Indeed, Broaddus and Ku (2000) find that lack of enrollment is a greater barrier than restrictive eligibility criteria among uninsured children; approximately 95% of low-income uninsured children in 1999 were eligible but not participating in either Medicaid or SCHIP (Broaddus and Ku 2000, p. 1).

To target outreach for Medicaid effectively in local areas, policymakers need to have the best information on take-up rates. *A take-up rate is defined as the proportion of people eligible for a program who are enrolled in it.*[1]

This paper examines Medicaid program participation among children in 1997 in Allegheny County,[2] Pennsylvania. A county-level estimate of take-up rates is needed because of a belief that levels and characteristics of conditions among potential Medicaid recipients in Philadelphia strongly dominates the state level take-up rates. This localized estimate will enable policymakers and local foundations to determine whether local Medicaid outreach efforts are needed, and if so, to which segments of the low-income population such efforts should be targeted. To derive the small-area estimate of Medicaid take-up rates among children in Allegheny County, we utilize

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[1] Ellwood (1999) reports that significant deterrents preventing participation in the Medicaid program exist beyond outreach. Namely, she cites challenges in severing Medicaid from welfare, complex rules and procedures, and the inadequacy of Medicaid automated systems as barriers to participation beyond outreach.

[2] According to 1990 Census figures from STF1A, Allegheny County, Pennsylvania had approximately 1,336,449 residents in 1990, 28% of whom resided in the City of Pittsburgh.

demographic and administrative data and an approach known as "Bayesian Demography" (Daponte, Kadane, and Wolfson 1998). The methodological framework we present for combining multiple sources of data into a Bayesian approach can be used generally to estimate programmatic take-up rates.

The method presented in this paper for estimation of Medicaid take-up rates also provides a framework for addressing the "Medicaid Undercount" problem. Reported data on Medicaid usage from surveys such as the Current Population Survey typically underestimate the number of children actually enrolled in the program as known from administrative data. While some believe that the discrepancy is due to reporting error, where respondents incorrectly report the health insurance status of persons in their household, the research this paper presents points instead to a possible and sizable undercount of poor children as derived from the U.S. Census.

Before presenting estimated take-up rates for Allegheny County, Pennsylvania, we first briefly review the literature on children's health insurance coverage and enrollment in Medicaid. Then, we discuss the estimation of the take-up rates, including an outline of the methodological issues. Finally, we conclude with a discussion of the take-up rates and their implications.

## II. REVIEW OF THE LITERATURE

A substantial body of literature contends that many children who are eligible for Medicaid assistance are not enrolled in the program. Summer, Parrott, and Mann (1997) at the Center on Budget and Policy Priorities examined Medicaid program participation among poor children. Their study relied on the Census Bureau's Current Population Survey (CPS) data combined for the years 1992 through 1995. They estimated Medicaid take-up rates and found that participation in the Medicaid program for children under 11 years of age ranges from 61 to 68 percent nationally, and between 59 and 72 percent in Pennsylvania (p. 14).

Also using the Current Population Survey of 1995, the General Accounting Office (GAO) estimated that in 1994, 20% of children eligible for Medicaid by federal mandate did not have *any* health insurance (US GAO 1996, p. 12). The GAO's 20% figure, therefore, implies that 80% is an upper bound for the national Medicaid take-up rate among these children.

Avruch *et al* (1998) estimated from the CPS that approximately 20% of all children under 11 years of age (or 13.8 million) were eligible for Medicaid (nationally). Of these children, 61% were enrolled in Medicaid and 17% were uninsured. They found that compared to children enrolled in the Medicaid program, eligible non-enrollees are about 60% more likely to be from two-parent families and more than twice as likely to be from a family where at least one adult worked full-time and full-year (Avruch *et al* 1998, p. 446). The implication from this is that many non-enrollees may be close to the borderline of Medicaid eligibility thresholds.

Schirm and Czajka (2000) estimate that nationally, 22% of children who were eligible for Medicaid in 1997 did not have health insurance. This estimate, also based on the CPS, reveals that the Medicaid participation rate for all children cannot exceed 78%. Their estimates further showed that in Pennsylvania, approximately 14% of Medicaid-eligible children in 1997 were uninsured (Schirm and Czajka 2000, Table I.3), implying a take-up rate of less than 86%.

Using data from the CPS, Pennsylvania Partnerships for Children (1996) found that 28% of non-insured children in Pennsylvania were eligible for Medicaid. The proportion of the non-insured children eligible for Medicaid decreases with age, with 36% of those under age 1 without insurance eligible for Medicaid; 26% of the uninsured between 6 and 13 years of age eligible for Medicaid, and 16% of the uninsured between 14 and 17 years of age eligible for Medicaid

(Pennsylvania Partnerships for Children, 1996, p. 5.). This decrease corresponds to increased stringency of Medicaid eligibility income thresholds as age increases.

One local estimate of child insurance participation comes from the Allegheny County component of the national Community Childhood Hunger Identification Project (CCHIP). The CCHIP survey included households in Allegheny County with at least one child under the age of 12 years and with an income below 185% of the poverty level. The survey found that in 1993, 10% of households included in the sample had at least one child who had no health insurance (Just Harvest 1994, p. 12). Further, the survey found that 17% of households did not seek medical treatment when it was needed, 8% of households reported they did not receive medical treatment because they were not able to pay for it, and 5% of households reported they did not receive medical treatment because of no health insurance (Just Harvest 1994, p. 12).

Considering why families do not enroll their children in the Medicaid program, research shows that potentially participating families have considerable misperceptions about how enrollment in Medicaid interacts with other social service programs. For example, the Southern Institute on Children and Families (n.d.) reports that from an analysis based on information obtained in focus groups, 39% of welfare recipients do not understand that if parents cease receiving welfare because they obtained a job, their children might still be eligible for Medicaid.

The GAO gives several possible reasons why families may not enroll in the Medicaid program:

> First, low-income families may not know that their children could be eligible for Medicaid even if a parent works full-time or if the family has two parents. . . . Second, getting enrolled in Medicaid is difficult for low-income families. In a previous report, we found that many Medicaid applicants never complete the eligibility determination process and about one-half are denied for procedural reasons; that is, applicants did not or could not provide the basic documentation needed to verify their eligibility or did not appear for eligibility interviews. Finally, some families many not seek Medicaid until they face a medical crisis or may not want to enroll in Medicaid because they consider it a welfare program and therefore stigmatizing (US GAO 1996, pp. 12-13).

Similar findings about non-enrollment are found for other social welfare programs. Daponte *et al.* (1997) asked a sample of people eligible for Food Stamps why they did not apply for them. A number of them gave answers consistent with "stigma." However, when informed that they were probably eligible for a sizable amount in Food Stamps, those households subsequently either enrolled in the Food Stamp program or gave reasons for non-enrollment inconsistent with stigma. That research also found that although many non-participants are ignorant of their eligibility status for a benefits program, when a poor population avails itself of information about a benefits program and when the program provides large benefits to participants (as the Medicaid program provides), nearly everybody eligible enrolls in the program.

This apparent under-subscription to Medicaid is at odds with the consistent under-estimation of Medicaid participation that comes from survey data--- the "Medicaid Undercount" problem, whereby administrative records show higher enrollment in Medicaid than survey data reflects. Administrative records from the Health Care Financing Authority (HCFA) indicate that in Fiscal Year 1998 (10/1/97 through 9/30/98), approximately 21.1 million children participated in

the Medicaid program at some time. In contrast, a study commissioned by the U.S. Department of Health and Human Services (Schirm and Czajka, 2000) estimate that only 19.3 million children were eligible for the program, implying a take-up rate of approximately 109%.[3]

Considering only infants, administrative records of Medicaid program enrollees show approximately 2.015 million infants (under the age of 1) participated at some point during fiscal year 1998 (HCFA 2000). According to analyses of the CPS done by the U.S. Census Bureau, 1.072 million infants were eligible for Medicaid (U.S. Census Bureau, unpublished data, based on the Current Population Survey 1997-1999). That is, estimates of the number of infants eligible for the Medicaid program based on the CPS yield a figure that is only 53% that of figures based on administrative data. Medicaid take-up among infants is thus estimated to be 188% of those eligible. Possible explanations for the discrepancy include substantial amounts of Medicaid fraud; underestimation of the number of infants from the CPS; or underestimation of the percentage of infants who meet the income-eligibility criteria for Medicaid. Some support for the hypothesis of the underestimation of the number of infants is shown in the work of Daponte and Haviland (2001), examining the undercount of children in the 1990 census.

## III. METHODOLOGY

The methodology used to obtain the estimate presented below differs from other approaches used to obtain estimates of participation in the Medicaid program in the sense that we exploit the fact that the Medicaid program knows from its administrative records the number of children participating in it with certainty. Because of uncertainties in the completeness of the various data elements that go into estimating the number of children eligible for the program, one cannot know the number of eligible children with certainty. Using Bayesian Demographic techniques (Daponte, Kadane, and Wolfson 1997), we combine uncertainty in the both the number of children, and the income distribution of the children, to estimate a range for the number of children eligible for the Medicaid program in Pennsylvania in 1997.

Daponte, Kadane, and Wolfson use and advocate the Bayesian Demographic approach to estimate a population where data quality is poor. However, their approach can be generalized to populations with high quality data but for which some data elements are uncertain; the higher the quality of the data, the less uncertainty there will be in the projected populations.

Using a Bayesian population projection with assumptions of income distribution overlaid is appropriate in this case for three reasons. First, the approach allows for elements of uncertainty to be taken into account. This is especially relevant because of the uncertainty in the income distribution. Second, we desire a population distribution by race and single years of age for 1997. A population distribution by single years of age is unavailable for 1990, requiring that broader age groups be mathematically split, an exercise that yields an uncertain product. Third, the Bayesian approach allows one to estimate the probable range of a population size and allows for uncertainty in the base (or jump-off) population and the vital rates (fertility and mortality) to which the population is exposed during the projection period. An additional source of uncertainty in this

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[3] Some of the discrepancy between these two figures is due to the time frame to which they refer. While the HCFA figure of 21.1 million is the cumulative number of participants during the year, the 19.3 figure applies to the number eligible during the year, based on the household's average monthly income.

analysis is the adjustments of the data for census undercount. The result of combining these sources of uncertainty into a cohort-component population projection is a probability distribution of an uncertain population.

The general approach of dividing the number of participants based on administrative data by the number of persons thought to be eligible for the program (based on census and economic data) avoids the traditional conception of the Medicaid undercount problem. That is, since we are not basing a Medicaid take-up rate on direct survey responses, the take-up rate obtained here should not be contaminated by weaknesses in questionnaire design, survey design, or the survey sample achieved.

To estimate the number of children eligible for Medicaid in 1997, we start by examining data from the last U.S. Census which was conducted in 1990. Our methodology has four steps, described briefly below.

1. **We project the population forward to 1997.**
   - We estimate an undercount-adjusted Allegheny County population for July 1, 1990. This is done by age, sex, and race (white, nonwhite).
   - We make assumptions about fertility and mortality between 1990 and 1997. An age pattern of fertility and level of fertility is applied to women of childbearing age, by 5-year age groups and race. Similarly, an age and sex pattern of mortality and level of mortality is applied to the entire population, by race.

2. **We estimate the probable range of the number of children eligible for Medicaid by applying income distribution assumptions to the projected population.**

3. **We estimate the number of income-eligible children on Medicaid by age and sex.**

4. **We obtain Medicaid take-up rates by dividing** the number of children on Medicaid by the number of children eligible for Medicaid by age and race.

IV. ESTIMATING THE NUMBER OF CHILDREN ELIGIBLE FOR MEDICAID IN ALLEGHENY COUNTY, PENNSYLVANIA IN 1997
   A. Estimating the Jump-Off Population
      To obtain the size of the population of poor children eligible for Medicaid in Allegheny County in 1997, we start with data from the 1990 census. Careful examination of 1990 United States census data presented by the U.S. Bureau of the Census reveals several problems with the data. For example, when examining birth and population figures for the State of Pennsylvania, one sees that in *Pennsylvania Vital Statistics, 1990*, census data show the population of Pennsylvania younger than one year of age as 139,208 (p. 9). However, the number of births to residents of the state is listed as 171,053 in 1990 and 168,108 in 1989 (p. 28). Clearly, a large discrepancy between births reported from birth certificates and infants counted in the census exists. The discrepancy would reflect the truth only if (1) the infant mortality rate approximated 180 deaths per thousand live births (whereas in 1990 it was actually 9.5 per thousands live births (Pennsylvania Department of Health, 1992, p. 93)); (2) there was a massive exodus of infants after birth; or (3) non-resident women were coming to Pennsylvania to give birth and the births were misreported as having been to Pennsylvanians. If either or both of the two latter situations had

occurred, then national statistics would not show a population-birth discrepancy, since the aggregate number of infants recorded by the census across all states would then mirror the number of recorded births for the nation.

However, data for the entire United States show a similar discrepancy. The enumerated population of infants (less than 1 year of age) was 3,204,504 (U.S. Bureau of the Census, Database C90STF3C1), but 4,158,212 births occurred in 1990 and 4,040,958 occurred in 1989 (National Center for Health Statistics, 1994). The STF1A file from the 1990 census shows 3,217,312 enumerated infants, while birth statistics show that there were approximately 4,071,745 births between April 1, 1989 and March 31, 1990, implying that 20.2% of infants in the United States on April 1, 1990 were not included in the 1990 census (Daponte and Haviland 2001).

In order to comply with the racial classifications designated by the Office of Management and Budget, as well as address problems with under-reporting of infants and general misreporting of age, sex, and race, the U.S. Census Bureau "adjusted" the age, race, and sex distribution of the enumerated population, resulting in the MARS (modified age-race-sex) files. (U.S. Bureau of the Census, March 1996).

The MARS adjustment is essentially a re-distribution of people from one age-race-sex category to another, and thus does not address the general problem of an overall undercount. The Census Bureau provided to the National Center for Health Statistics estimates of inclusion in the 1990 census based on comparing the enumerated data (prior to MARS-adjustments) with population estimates obtained using the Post-Enumeration Survey. According to these estimates, the 1990 census data only includes about 98% of the US Population (NCHS 1994, Section 7, p.31). Considerable differences in enumeration exist among race, age, and sex categories. The census captured 97.3% of white males, but only 91.5% of black males. Of all groups, enumeration of people in their twenties was worst. Females were better enumerated than males, but the census only included 98.7% of white females and 97% of black females (NCHS 1994, Section 7, p.31).[4] Some believe (e.g. Kadane 1997) that the bureau's estimates of underenumeration are biased downward, and that the true proportion of the US population included in the Census is actually lower than the 98% figure.

Groups that are undercounted in the census tend to disproportionately come from minority races, children, renters, and the economically disadvantaged. Thus, in a careful estimation of the Medicaid-eligible population of children, the population estimates need to be adjusted for the census undercount. This can be done by estimating "inclusion ratios", the percentage of each age, sex, and race population sub-group that was counted in the census, at the state level. These are derived from information obtained from the Post-Enumeration Survey (Hogan, 1992; Anderson and Fienberg, 1999).

Figure 1 displays the inclusion ratios for the state of Pennsylvania,[5] which reflect *the proportion of people included* in the Census Bureau's MARS-adjusted population estimates for

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[4]Bangs and Hong (March 1996, p. 42) estimated that "10-15% of black men age 25-54 and 2-3% of black women age 25-54 were missed in 1990 census counts." They estimate in the Milwaukee, WI CMSA, one-quarter of black men ages 25-54 are not included in the 1990 STF data.

[5]The Census Bureau has released the Adjustment-Difference Matrix which includes for each 5-year age group, sex, and racial classification, the difference between the MARS-adjusted

Pennsylvania. For example, this figure shows that the Census Bureau's MARS-adjusted estimates of children include over 98% of all white children aged 0-19, but only around 92% of all non-white children. For comparative purposes, it should be noted that the inclusion ratios for the raw (STF3) 1990 census data are even further from 100% than the ratios presented for the MARS-adjusted population; the raw inclusion ratios are also displayed in Figure 1. Without the MARS adjustments, the inclusion ratios for infants are about 81%-82% for whites, and 67%-68% for non-whites, clearly demonstrating the need for the MARS adjustment, as well as an adjustment for overall undercount. The best estimate of the actual population, then, is the MARS-adjusted population, divided by the inclusion ratio for each combination of age, race, and sex.

The MARS-adjusted population is available for each county in the country, and we start with the July 1, 1990 (midyear) MARS-adjusted population for Allegheny County, PA. Then, we adjust this population based on the April 1, 1990 MARS Inclusion Ratios for the Commonwealth of Pennsylvania. That is, we let the Allegheny County estimated population for July 1, 1990 equal the MARS-adjusted population for Allegheny County for July 1, 1990 divided by the MARS Inclusion ratio for the Commonwealth of Pennsylvania. This yielded a population with more children than typically reported by the Census Bureau and somewhat fewer elderly people (the 1990 census double-counted many of the elderly).

Estimating take-up rates from a more accurate estimate of the population, derived from US Census Bureau estimates of undercount in the 1990 census, prevents an artificial inflation of the rates from including too few children in the denominator of the calculation. Table 1 displays a) the fully (MARS and Undercount) adjusted population, and b) the net difference between the fully adjusted and only MARS-adjusted populations. The undercount adjustment increased the population under the age of 20 for all races by 7,088 persons, or by 2.2%. For whites and nonwhites, the undercount adjustment increased the population by .9 and 9 percent, respectively, a considerable difference. The overall adjustment for all age, sex, and race groups was to increase the population by 0.5%.

### B. Bayesian Population Projection

The fully adjusted population was projected from midyear 1990 (the year of the last census) to 1997 using a Bayesian cohort-component projection. Since we do not know, beyond the figures provided to us by the Census Bureau, the additional margin of error in the population estimates, we conservatively assume that this population is known with certainty

**Fertility.** Women of childbearing age (15-49) are aged through a statistical fertility schedule. The level of fertility selected in a projection is quite important, since, for example, the population under the age of 6 in 1996 is purely a function of a demographer's imaginative assumptions. The fertility rates were obtained by taking into account the number of births in Allegheny County in 1990, throughout the 1980's and 1990's, and the size of the population of childbearing age by 5-year age groups. The denominator of the fertility rates was the fully adjusted number of women of childbearing age by 5-year age groups. For the projection, we assumed that the distribution of the total fertility rate in 1990 was:

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population and what the bureau would consider a fully enumerated population. Dividing the enumerated population by the enumerated population plus the Adjustment-Difference figures, one obtains the inclusion ratios for a MARS-adjusted population. Because of unavailability of data, one cannot obtain MARS inclusion ratios for an area more local than the state.

|          | Median | 2.5% | 97.5% |
|----------|--------|------|-------|
| **White**    | 1.61   | 1.55 | 2.0   |
| **Nonwhite** | 2.37   | 2.1  | 2.6   |

Based on these "elicited" quantiles of the fertility distribution, we used the *BestFit* package to find a parametric distribution that had empirical quantiles most closely resembling those given. For Whites, the total fertility distribution was fit using a lognormal distribution with a mean of -2, a standard deviation of .65, and a shift parameter of 1.45. For non-whites, the best-fitting parametric distribution was given by a Gamma (365,162) distribution. These are displayed in Figure 2. Fertility is assumed to be relatively constant throughout the projection period. The number of births in 1997 in Allegheny County known from vital registration statistics falls within the assumed range.

       **Mortality.** We first determined 1990 patterns of mortality separately for white and black populations by calculating mortality rates by age, sex, and race for the United States. The number of deaths derived from death certificate data was used as the numerator of the mortality rates, and the national fully-adjusted population was used as the denominator. This was done at the national level because a pattern of mortality at a more local level would not be statistically reliable. Using the fully-adjusted population as the basis of the life tables statistically increases life expectancy at birth among black males by about one-half of a year.

       The infant mortality rates (IMRs) were used to adjust the national patterns of mortality to correspond to the observed infant mortality in Allegheny County. Since infant mortality rates are calculated by dividing the number of deaths to infants by the number of births during the year, they do not incorporate any of the undercount issues included in the census.

       Infant mortality in Allegheny County has decreased from 12.9 deaths per thousand births in 1985 to 9.4 in 1990, to 9.0 in 1995. Allowing for uncertainty in the infant mortality rate, we projected the infant mortality rate by using a logistic function (with asymptotes of 20 and 5) and based on the following levels:

| Year | Median | 5% | 95% |
|------|--------|-----|------|
| **1990** | 9.4    | 8.5 | 10.3 |
| **1995** | 9.0    | 8.2 | 9.8  |

       We distributed the projected overall level of infant mortality sampled from normal distributions defined by the given quantiles to sex and race categories based on the 1994 sex and race-differentials in infant mortality (1994 was the only year for which these differentials in Allegheny County were available). Data for 1994 showed an infant mortality rate of 6.25 for white males, 5.41 for white females, 19.85 for black males, and 16.06 for black females. Throughout the projection, infant mortality among whites was not allowed to be lower than 5 deaths per thousand births. The resulting sex and race specific infant mortality rates that were derived for 1990 and 2000 are shown in Figure 3. Sex and race specific infant mortality rates for any intermediate time periods are interpolations between the 1990 and 2000 rates.

       **Migration.** Migration is usually the most uncertain component of the population to estimate, and we do not include assumptions of it in this projection. In this case, the only migration with which to be concerned involves permanent inter-county net moves. Therefore, for the projection, one needs assumptions on the level and age-sex race pattern of net migration. Migration data between censuses is notoriously poor, and we feel that a migration assumption

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would decrease the credibility of the data. We could not locate any data of quality high enough upon which to base a migration assumption. Further, migration assumptions would have a very minimal impact (we suspect less than .5%) on the estimate of eligible children, since poor children are not known to be highly migratory.[6]

Table 3 shows the Bayesian estimated projected population of persons below 19 years of age by race, based on the assumptions described above for fertility, mortality, and migration. Based on our calculations, with 90% certainty, the population of persons below 19 years of age ranged from 308,665 to 240,843, with a mean of 320,435. The 90% credible interval of the white population younger than 19 years ranged from 249,923 to 277,328 and for the nonwhite population ranged from 58,742 to 63,515.

## V. Medicaid Eligibility

To obtain the number of children eligible to receive Medicaid, we considered the following eligibility requirements of the program in 1997 (Commonwealth of Pennsylvania 1997, Appendix D):

|  | Age (in years) |
| --- | --- |
| Household income threshold | 1997 |
| less than 185% of poverty level | <1 |
| less than 133% of poverty level | 1-5 |
| less than 100% of poverty level | 6-13.5 |
| less than 44% of poverty level | 13.5-18 |

The actual household income threshold for Medicaid is a bit more complicated than above. For a child 6 years of age or older, the household income threshold is 100% of poverty if he or she was born after September 30, 1983. This means that the age at which a child above the age of 6 years is eligible at the 100% threshold rather than the 44% threshold changes daily. The estimation of the eligible population mathematically takes this complication into account.

In essence, to obtain the Medicaid-eligible population of children in 1997, we project the population from 1990 to 1997 and overlay economic assumptions to estimate the number of children at various poverty thresholds by age and race. These figures constitute the denominator of the take-up rates.

Because of a lack of detailed, reliable, recent data on income relative to poverty level in Allegheny County, we rely on data for the United States. Data from the 1993 CPS indicates that 21% of Allegheny County's children live below 100% of the poverty level, whereas the comparable figure for the United States was 22% (US Census Bureau 1996, p. 472). When comparing income levels between Pennsylvania and the entire country, one observes that the median household income of Pennsylvania does not significantly differ from that of the entire United States (U.S. Census Bureau 1997, p. xii). For example, the 1995-1996 median household income for the United States is $35,287 whereas for Pennsylvania it is $35,221. Per capita income in 1997 in the U.S. and Pennsylvania was $25,288 and $25,670, respectively (U.S. Census Bureau

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[6] Data from the 2000 census suggests net outmigration from the county, perhaps making the denominator of the take-up rates somewhat inflated.

2000, Table 733). We feel confident that applying U.S. figures to Allegheny County, allowing for uncertainty in the estimate, is reasonable.

In order to estimate the number of children in the county who are eligible for Medicaid assistance, we need to be able to determine what proportion of children in each age, sex, and race subgroup are below the income thresholds for eligibility. To estimate these proportions, we begin with aggregate data from the CPS on the national proportion of children of all ages living below various poverty thresholds (shown in Table 3). For children below 100% of the poverty line, the proportions can be further broken down by single years of age (shown in the second and third columns of Table 4). Although the percentage of children living below 100% of the poverty line varies from age to age, the overall pattern is that poverty is quite prevalent among the youngest children, and then decreases as children (and their parents) age.

To obtain age, race, and sex specific proportions of children falling below various poverty thresholds, define $P(i,j)$ to be the percentage of children in the $i$th age group,

$i = \{0,1,2,\ldots,18\}$, who are below the $j^{th}$ percentage of poverty, where

$j = \{44\%, 100\%, 133\%, 185\%\}$. Letting $P(\bullet,100)$ be the proportion of *all* children of a

particular race who are below 100% of the poverty line, set $P(\bullet,100) \sim N\left(\mu_{\bullet,100}, \sigma_{\bullet,100}\right)$, with

parameters defined separately for the White and Non-White populations as:

|  | $\mu_{\bullet,100}$ | $\sigma_{\bullet,100}$ |
|---|---|---|
| 1997 White | 16.2% | 0.5% |
| 1997 Non-White | 33.7% | 0.5% |

Age-specific percentages of children who are under different poverty thresholds are derived separately for each racial category from $P(\bullet,100)$ using the relationship

$$P(i,j) = P(\cdot,100) \cdot A(i) \cdot B(j).$$

Here, $A(i)$ is a factor that relates the percentage of children in the $i$th age group who are below 100% of poverty to the percentage of all children who are below 100% of poverty, and $B(j)$ is a factor relating the percentage of all children under age 18 who are below the $j$th percentage of poverty to the percentage of all children under age 18 who are below 100% of poverty (thus $B(100)=1$). Both $A(i)$ and $B(j)$ can be estimated from the publicly available CPS data. One possible criticism of this strategy is that it assumes that the age-specific pattern of poverty rates remains similar at different poverty levels.

To obtain the $A(i)$ factors, we fit smoothing splines (Hastie and Tibshirani, 1990) to the CPS data specified in Table 3 and the second and third columns of Table 4. The choice of smoothing splines is so that we can adequately represent the nonlinearity in the age relationship shown. To reflect the uncertainty in the fit of the smoothing spline, we actually sample the $A(i)$'s from a normal distribution with a mean given by the fit of the smoothing spline, and standard error obtained through cross-validation. Figure 4 shows the fitted smoothing splines and the associated error bars.

Surprisingly, to obtain the poverty level factors (the $B(j)$'s), a linear model relating the percentage of children below given poverty levels to the proportion below 100% of the poverty level is adequate. The regression models fit for each year and race are shown in Figure 5, and the extremely high $R^2$ values are almost certainly an artifact; it seems likely that the published Census Bureau figures were themselves generated from a linear model. Nonetheless, we use the data, and sample the $B(j)$'s from a multivariate normal distribution, parameterized by using the mean of the fitted regression model to the ratio of various poverty levels to 100% of poverty, and a covariance matrix for predictions from that linear model.

The leftmost columns of Table 4 show the resulting bounds on the estimates of the proportion of children that are income-eligible for Medicaid assistance. Table 4 shows that substantial racial differences exist with respect to the proportion of children eligible for Medicaid. In all age categories, a larger proportion of nonwhite children are eligible for Medicaid than their white counterparts. We estimate that while approximately 36% of White infants are eligible for Medicaid, 58% of Non-White infants are eligible. At age 14, we estimate that between 3.5 and 5.0 percent of Whites are income-eligible for Medicaid and between 13.3 and 19.7 percent of Non-Whites are income-eligible, which can be interpreted as non-whites having nearly four times the eligibility rate of whites in this age group. The decline in the proportion eligible as age increases reflects the more stringent eligibility criteria set for the program for older children.

To obtain the number of children eligible for Medicaid assistance, by age and race, we apply the estimates of the eligibility rates to the estimates of the population size. Table 5 displays the Bayesian estimates that result, showing that according to our methodology, between 55,600 and 73,600 children in Allegheny County were income-eligible to receive health insurance through the Medicaid program in 1997.

## V. CHILDREN ENROLLED IN THE MEDICAID PROGRAM

The Pennsylvania Department of Public Welfare provided data on the number of children enrolled[7] in the Medicaid program in Allegheny County. While we wanted the data by single year of age at mid-year (July 1) 1997, the Department of Public Welfare only could provide data referring to July 1997 on the total number of cases, the number of cases below the age of 6 years, and the number of cases between the ages of 6 and 17 years. These data were not broken down by race or by finer age categories. The Department of Welfare's Client Information System indicates that in Allegheny County, in July 1997, there were 26,715 children younger than 6 years of age, 37,808 children 6-17 years of age, and 7,007 people 18-21 years of age enrolled in the Medicaid program (Pennsylvania Department of Public Welfare, personal communication).

The Department of Public Welfare also provided the number of Medicaid cases by detailed racial category and single year of age for August 1997 (see Table 6). Applying the age and racial distribution of Medicaid cases in August 1997 to the total number of cases in July 1997, we estimated the number of children receiving Medical Assistance by race and single year of age in July 1997.

Generally, to be eligible for Medical Assistance, a child's family needs to fall below a certain eligibility threshold, depending on the age of the child but regardless of family assets. However, there are ways that a child can receive Medical Assistance although the child's family's

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[7] The Department of Welfare refers to enrollees as "eligibles."

income exceeds the above income threshold. For example, a child participating in the SSI-Disability program receives Medical Assistance, regardless of the child's family's income. In Allegheny County, there were approximately 1,300 such children.[8] Also, about 5% of children receiving Medical Assistance in the Commonwealth receive it because of "spend down"--- their families are above the income thresholds, but they have medical-related financial obligations that when subtracted from a family's income, make the child eligible for Medical Assistance. Since it is unclear what the denominator of a take-up rate would be for these alternative ways of participating in the program, we restrict the take-up rate here to those who are income-eligible for the program. Thus, children who are not income-eligible to participate in the program were excluded from the numerator of the take-up rate.

Table 6 presents the number of income-eligible children estimated to be receiving Medical Assistance in Allegheny County. In 1997, approximately 58,000 income-eligible children (below 18 years of age) received health insurance provided by the Medicaid program. Children account for approximately 45% of all Medicaid cases. Of all children enrolled in the Medicaid program in Allegheny County, 46% are White and 54% are Non-White.

Overall, as age increases, the number of children receiving Medical Assistance decreases; this is clearly shown in Table 6. However, if all children in a given age group were taking full advantage of their income-eligibility for Medicaid, then one would expect to see sharp drop-offs in enrollments at ages where the poverty threshold for eligibility changes, such as between infants (eligible at 185% of the poverty threshold), and 1 year olds (eligible at 133% of the poverty threshold), and at the next dropoff at the sixth birthday (to 100% of poverty). A similar change should be viewed for 13 year olds[9]. Figure 6 shows, via *eligibility criteria*, the expected range of the drop-offs that should be viewed; but the age pattern of children actually on Medicaid, however, shown in Table 6, does not show large decreases in enrollments as the criteria change. Instead, as age increases, enrollment first rises and then rather steadily decreases. For both races, enrollment *increases* between ages 0 and 1 although the eligibility threshold changes from 185% of poverty to 133% of poverty. Between ages 5 and 6, the eligibility threshold decreases to 100% of poverty, and enrollment *decreases* by only 72 children. Then, at age 12, when eligibility becomes restricted to children below 44% of the poverty threshold, the number of cases decreases by only 352 children.

We speculate that **a large decrease in the number of participants at ages when the income criteria for participation become more restrictive (ages 1, 6, and 13) does not materialize because children living in households with incomes close to the income thresholds tend not to participate in the Medicaid program.** The data show that Medicaid tends to serve the children with incomes below the next age category's threshold, or the poorest of the particular age group ---only the poorest of the poor actually receive Medical Assistance, given that we do not observe the expected exodus of children from the program upon reaching critical birthdays (1, 6 and 13). Therefore, we believe that children ages 1-5 who reside in families with

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[8] Pennsylvania Department of Public Welfare, Client Information System Report, 2/7/98.

[9] It is problematic to discuss the thirteenth birthday here since cohorts are aged into the higher income threshold--- all children born after September 30, 1983 are eligible at the 100% of poverty level threshold.

incomes between 100% and 133% of the poverty level, and children ages 6-13 with incomes between 44% and 100% of the poverty level tend not to participate in the Medicaid program.

## VI. MEDICAID TAKE-UP RATES

To calculate the Medicaid take-up rate by age and race, the number of income-eligible children on Medicaid was used as the numerator and the projected number of children eligible for Medicaid was used as the denominator. This simple calculation yielded very peculiar results (see Table 7 and Figure 7). A take-up rate (the proportion of people eligible for a program who participate in it) is theoretically bounded to lie between 0 and 1. A rate greater than 1 indicates that the population receiving program benefits *exceeds* the number of eligible people thought to exist.

Considering all infants, the 90% credible interval of the take-up rate ranges between 30% and 72%. For white infants, the take-up rate approximates 34 %, and among white children 1 through 5 years of age, slightly fewer than half of all eligible children (with the rate ranging from the mid-.20s to low-.60s) utilize the program. Among white children 6 through 12 years of age, about 70% of eligible children participate in the program. At the oldest ages, when the program is offered only to adolescents who live below 44% of the poverty threshold, the take-up rates surely exceed 1, as shown in Figure 7.

For nonwhites, the mean of the take-up rate equals or exceeds 1 even starting with infants. While one observes a similar pattern among the take-up rates of the nonwhites, the rate exceeds its theoretical bound for nonwhites even at the youngest ages. According to our estimates, between 55 and 146 percent of nonwhite infants eligible to receive Medicaid participate in the program. For ages 1 through 5, there seems to be approximately 120-130% of as many children on Medicaid than one expects are eligible for the program, with the lower bound of the estimate being plausible. At age 6 through 12, the mean of the take-up rate exceeds 1 (1.48-2.03), with the higher bound of the credible interval exceeding 2.

At ages 13 and above, when the eligibility criteria become extremely restrictive, even the lower bound of the credible interval exceeds 1 for both Whites and Non-Whites. Among White teenagers, there appear to be between 1.6 to 4 times as many children participating in the program than seem eligible for it, and among Non-White children, participation in the program exceeds eligibility by a factor of 2.5 to 6 or 7.

## VII. EXPLANATIONS

What could cause the take-up rate calculated in this way to exceed 1? Since there are essentially only three inputs into calculating the take-up rate, we consider each separately.

1. **The program might not serve only the intended population.** One possibility is that the program is not being implemented as intended. For example, to account for some of the discrepancy, one can imagine a scenario where persons close to but above the income threshold modify their actual or reportable income in order to receive the program's benefits, or that program administrators opt to enroll marginally ineligible persons in the program. If there were fraud of this nature, the degree of the fraud would have to be massive to account for the differential.

Thirty-four states have take-up rates that exceed 100% and six more states have take-up rates that exceed 90% if one uses for the numerator the number of children enrolled in the

Medicaid program (based on HCFA data) and for the denominator the population thought to be eligible (Schirm, and Czajka 2000) based on annual family income as reported in census and CPS data. Figure 8 shows the results of this calculation by state. While this calculation has some slippage, clearly, non-plausible take-up rates seem to be widespread.

2. **Substantial undercount of the poor population in the 1990 census.** We performed many adjustments to obtain a more realistic base population, including adjusting for Census Bureau-estimated undercount and projecting the population with uncertainty. This adjustment may have had limited success because undercount estimation is not available by economic status and it is likely that the economically disadvantaged are disproportionately undercounted.

We suspect that the undercount was large for the very poor population, both white and non-white, but disproportionately larger among black children who have a greater tendency to live below the poverty threshold. If undercount is more severe among the poor, our adjustments for undercount may have had only limited success.

Unfortunately, the post-enumeration survey of the 1990 census, upon which undercount estimates are based, did not collect information on income. Therefore, it is difficult to assess the proportion of the poor population missing from official demographic estimates. However, several sources of data viewed together in this context seem to suggest that the undercount among the urban poor was substantial. For example, the number of children collecting AFDC in Philadelphia County in 1989 (approximately 135,000) exceeds the number of children in the county reported in the census (approximately 113,000) as below 100% of the poverty level (Steketee and Bergsten 1997). Undercount rates of renters exceed those of homeowners, and net census undercount of the black exceeds that of the non-black population (Anderson and Feinberg 1999, p. 122). Our analysis here suggests further reason for using caution in relying on US Census Bureau figures that relate to poor children.

We did a back-of-the-envelope calculation to see whether the take-up rate would still exceed 1 if we assume that *all* of the children by age and race that the Census Bureau believes it did not count in the 1990 census were eligible for Medicaid and use the highest estimate (95th percentile of the credible interval) of the population. Considering, for example, non-white children aged 10-14, if we use the highest estimate of the number of eligible children (4,699), and add to that all of the children undercounted in that age category (1,086), we estimate that approximately 5,700-5,800 children would be eligible. Since nearly 7,300 income-eligible nonwhite children 10-14 are enrolled in the Medicaid program, the take-up rate would still exceed one (7,300/5,800). *Even if every child undercounted in the census (as estimated by the US Census Bureau) were eligible for Medicaid, the take-up rate would still exceed 100% for the problematic age-race categories.*

3. **Estimation of the income distribution of children (based on the Current Population Survey).** Recent estimates of income distribution are based on the Current Population Survey (CPS), conducted by the U.S. Census Bureau. Others have questioned the CPS and Census figures on the poor population. When comparing CPS estimates of the number of children on Medicaid in Pennsylvania with Department of Welfare administrative records of Medicaid usage, one observes an enormous discrepancy. The CPS estimates (March 1997 supplement)

show about 512,000 children on Medicaid in 1996,[10] [11] whereas the Department of Welfare shows about 734,000 children on Medicaid in 1996.[12] [13]. Clearly, the 30% underestimate of Medicaid cases provides support for a hypothesis that CPS-based figures do not include a substantial portion of Pennsylvania's poor population.

Other analysts have estimated take-up rates of Medicaid by utilizing information from the CPS. A problematic issue in their work is the use of weights (to generalize rates obtained from the CPS to the entire population) that were constructed to yield census-consistent estimates. This methodology can yield severely erroneous statistics on the poor population. The undercount issue presents itself in 1990 census data *and* CPS estimates--- the data and CPS weights, according to U.S. Census Bureau estimates, leave *8% of black children entirely out of the figures*. This means that to obtain a more realistic population estimate of, for example, black children 10-14 years of age who have a MARS Inclusion Ratio of .914, one would add 9.4% ((1-.914)/.914) more children to the MARS-estimated population. These children, however, may not be evenly distributed across the income distribution--- a disproportionate number excluded from official statistics may be poor.

The United States Government Accounting Office (1996, p. 19) notes that nationally, estimates of Medicaid enrollment based on the CPS are far below estimates based on the number of actual enrollees reported in the system. As we have mentioned previously, figures on Medicaid participation of infants based on the CPS are only 53 percent of those based on administrative records (U.S. Census Bureau 2000; HCFA 2000).

In order for misreporting of the income distribution to account for the discrepancy observed between the Medicaid-eligible and Medicaid enrolled populations, one would have to believe, for example, that about 40% of Non-White 14-year olds live below 44% of the federal poverty level. This would imply that the proportion of the child population that is poor is severely underestimated in Allegheny County (and probably in the nation). There would need to be gross misestimation of poverty among children for this to account for the entire differential in take-up rates.

Walking through a simple calculation for the infant population (an ideal reference group, since birth certificate records allow us to have more certainty about the population) can provide insight to "true" poverty levels. In 1997, there were approximately 3,853,000 infants in the U.S.

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[10] Martha Bergsten's (Pennsylvania Partnerships for Children) analysis of the CPS.

[11] One might question why Pennsylvania, in Appendix C of the "Model Application Template for State Child Health Plan under Title XXI of the Social Security Act State Children's Health Insurance Program" reports 701,000 children on Medicaid and cites the CPS as the source of this figure. The Commonwealth actually used the CPS's racial and age distribution to distribute the total number of cases based on the Department of Welfare's database. Had Appendix C been based solely on the CPS, as is reported, then the number of Medicaid cases would have been closer to 500,000.

[12] Pennsylvania Department of Public Welfare, "Client Information System, Cash/Medical Statistical Analysis, State Level."

[13] Our thanks to Martha Bergsten for making us aware of this discrepancy.

According to administrative data, 1,653,938 infants (43%) participated in the Medicaid program at some time during FY1997. Eligibility criteria for Medicaid program participation was <185% of poverty in 1997, implying that at least 43% of infants fall below 185% of poverty. However, figures from the CPS imply that an average of 40.7% (with 36.7% and 44.7% reflecting the 5th and 95th percentiles of the confidence interval) of infants fall below 185% of poverty. Estimates of the proportion of infants below 185% of poverty can be viewed as consistent with Medicaid records only if one assumes that program's take-up rate is 100%. Even if the take-up rate for the program is as high as the 84% that the Urban Institute calculates (Lewis et al 1997, Table 4-2), then the proportion of infants estimated to be below 185% of poverty climbs to 51% - well outside the confidence interval derived through the CPS.

## VII. CONCLUSIONS

To estimate the degree of program participation, we have designed a novel methodology that accounts for several sources of uncertainty in the inputs to the calculation. We adjust population figures for undercount, allow for uncertainty in the baseline data, and examine each data element quite critically. Further, our estimates utilize information *known* about the program--- the number of children enrolled in it--- to the fullest extent.

Adjusting for undercount manifests itself not only in the base population used, but also in the vital rates used. For example, the life table used for black males based on the undercount-adjusted population yields a life expectancy at birth one-half of a year higher than that used by the National Center for Health Statistics. In this sense, our estimated eligible population was somewhat larger than what others estimate, meaning that if any bias exists in our calculations at all, it is to *under-estimate* take-up rates.

Our analysis shows that in some age groups, not all children eligible for health insurance through the Medicaid program receive it. Enrollment among infants seems to be lacking. Among White children 10 years and younger, take-up certainly is less than 100%. Past research suggests that enrollment might increase if (1) parents had greater awareness of the eligibility criteria and application process for the Medicaid program, and (2) barriers (literacy, transportation, opportunity costs) to participation decreased.

Populations to target for increased enrollment include children near the Medicaid income eligibility threshold and infants and young children. Families that have never before relied upon public assistance might also be another fruitful audience to target. It is likely that these potential program participants do not reside in "poor" neighborhoods.

The data issues raised in this analysis are substantial. Clearly, this triangulation of data shows that statistics on poor children are not of acceptable quality. The fact that for white children above the age of 12 and for nonwhite children at least 1year of age there appear to be more children on Medicaid than appear to be eligible for the program implies that there might be serious problems with either the population figures or the estimates of poverty levels. Policymakers cannot effectively plan programs for their constituents without having reliable, credible data. What is worse, however, is that typically policymakers rely on non-MARS-adjusted census data for drawing conclusions about a local population.

Programs intended to benefit the poor, designed based on census or CPS data, will struggle to keep up with the demand for services or benefits, since embedded in the program's design is an underestimate of the target population, and consequently, a shortage of services or benefits. It is imperative that the United States improve its statistical system so that the needs of the poor can be

adequately addressed.

Areas where more research is needed include understanding the shortfalls of statistics on the U.S. low-income population and experimental and ethnographic research to understand how the poor perceive a program's benefits, whether barriers to participation in benefits programs exist, and how policymakers can most effectively communicate the benefits of participation to persons in need.

## Figure 1
## Inclusion Ratios for Pennsylvania, April 1, 1990 by Age, Race, and Sex
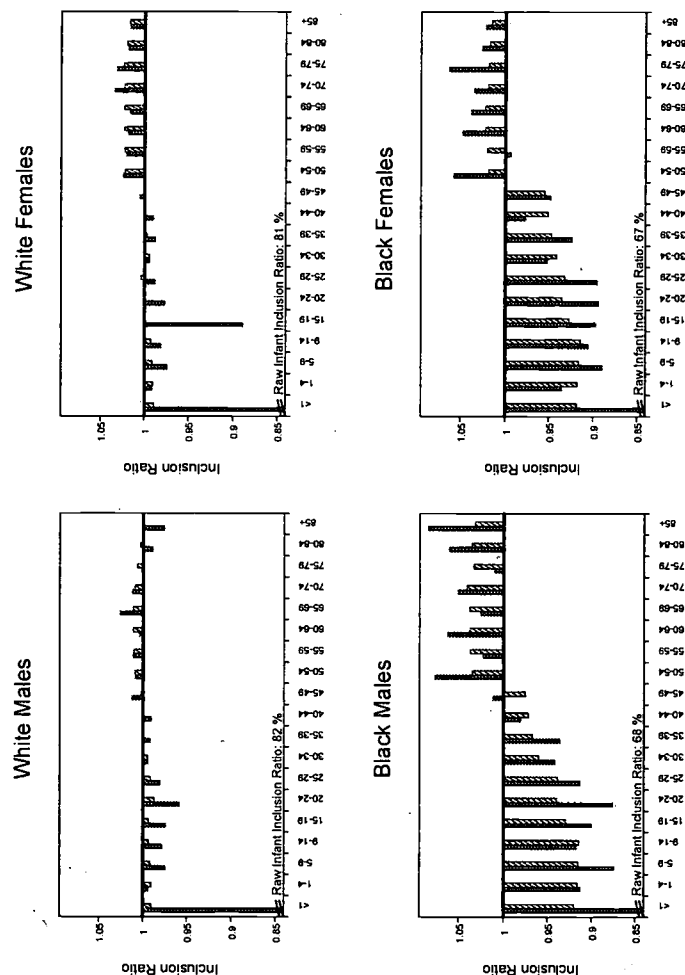


Raw (solid bars) and MARS-Adjusted (dashed bars) inclusion ratios for Pennsylvania, by age, race and sex. Data for these tables was derived from U.S. Census Bureau Data. The inclusion ratio represents the proportion of the population in the particular age, race, and sex category that is included in U.S. Census Population estimates. This graph shows the general trend that children are undercounted (most dramatically for infants), and older age groups are over-counted, and that the MARS adjustments improve the "miscount" for all age-race-sex categories.

## Figure 2
## Elicited Total Fertility Rates
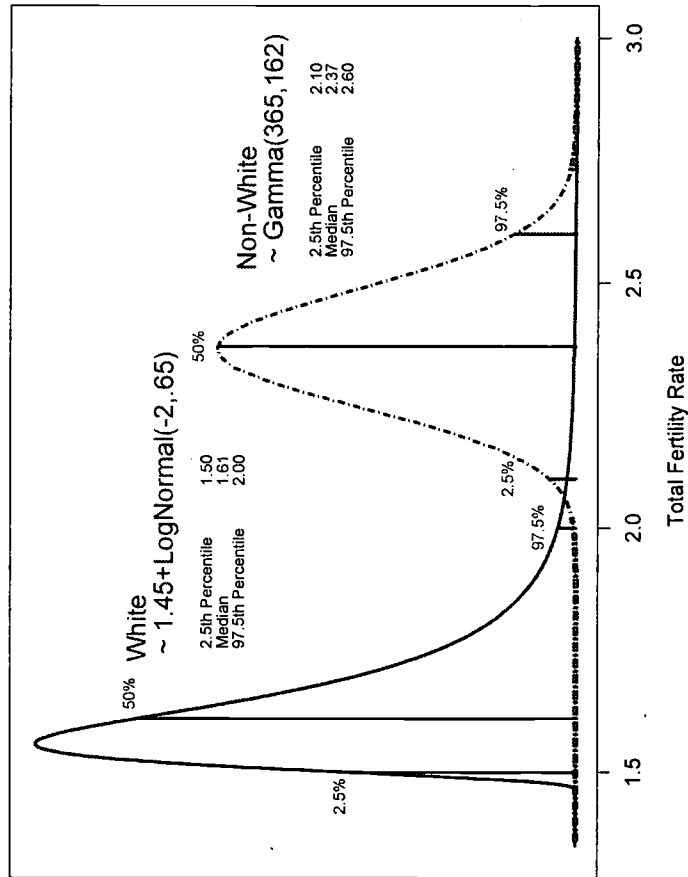


The elicited total fertility rates for Whites (Solid Line) and Non-Whites (Dashed Line), together with the best-fitting parametric distribution.

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24

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# Figure 3
# Infant Mortality Rates

(A) All Races, Both Sexes



| | |
|---|---|
| 1990 | Elicited |
| 1995 | Elicited |
| 2000 | Projected (Logistic) |

Joint Infant Mortality Rate

| | |
|---|---|
| 1990 | Males |
| 1990 | Females |
| 2000 | Males |
| 2000 | Females |

(C) Non-Whites



Infant Mortality

(B) Whites
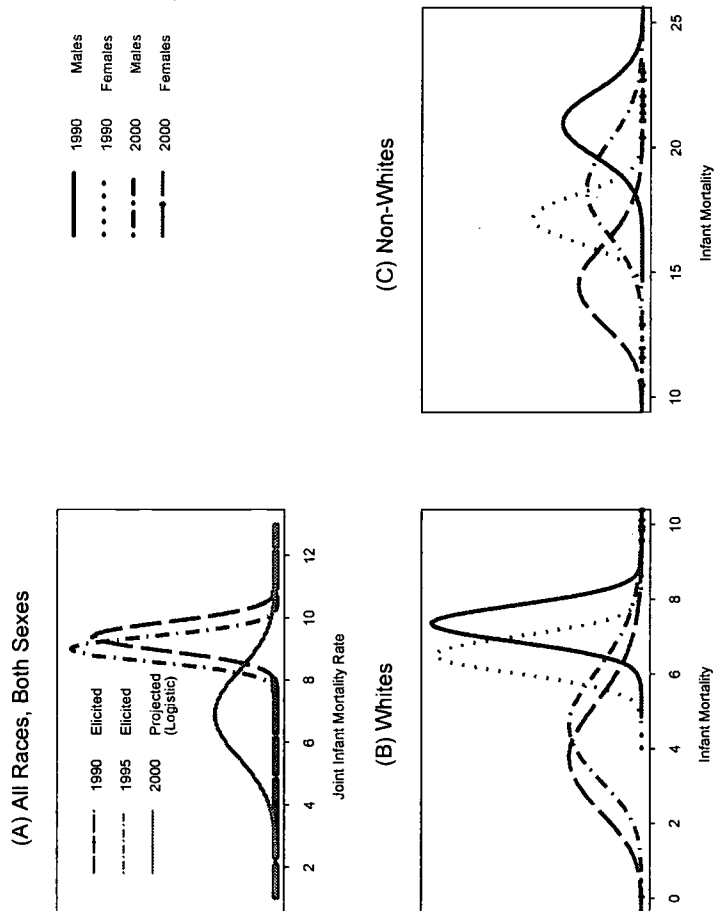


Infant Mortality

The overall joint infant mortality rate for all sexes and races combined as derived from published data for 1990 and 1995, and projected through a logistic function for 2000, are shown in panel (A). Panels (B) and (C) show, respectively for Whites and Non-Whites, the distribution of infant mortality rates separately for each sex in 1990 and 2000. The distribution of race-sex specific infant mortality rates for any year between 1990 and 2000 can be derived by interpolating between the two curves.

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## Figure 4
## Age Distribution of Children under 100% of the Poverty Line
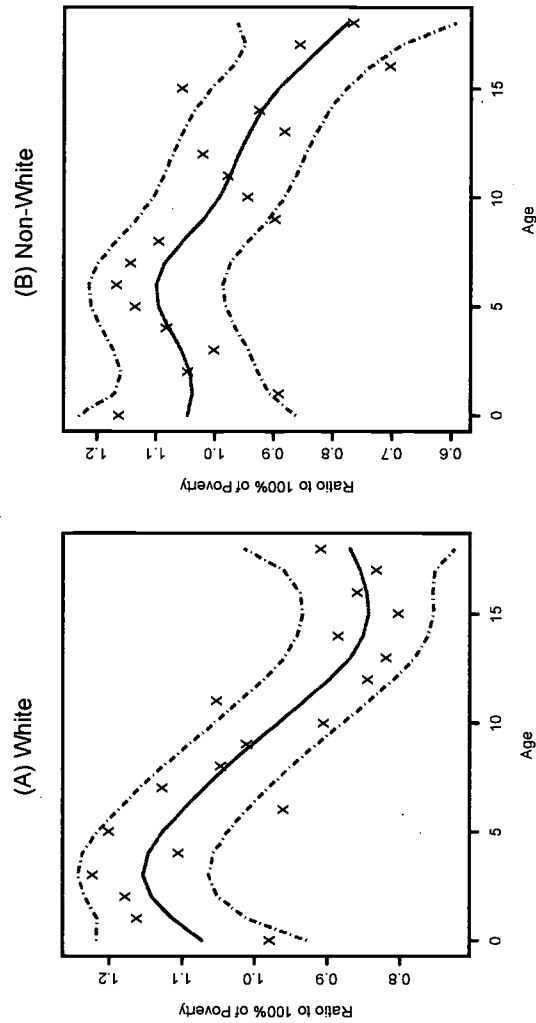


This figure shows smoothing splines (Hastie & Tibshirani, 1990) fitted (solid line) to the ratio of single year of age poverty rates to the overall under 18 poverty rate (displayed as "x"'s), for children under 100% of the poverty line. Also shown are approximate 95% confidence bands (dashed lines).

# Figure 5
## Relative Distribution of Poverty Thresholds to 100% of the Poverty Line



(A) White

R-Sq= 0.999

(B) Non-White

R-Sq= 0.992
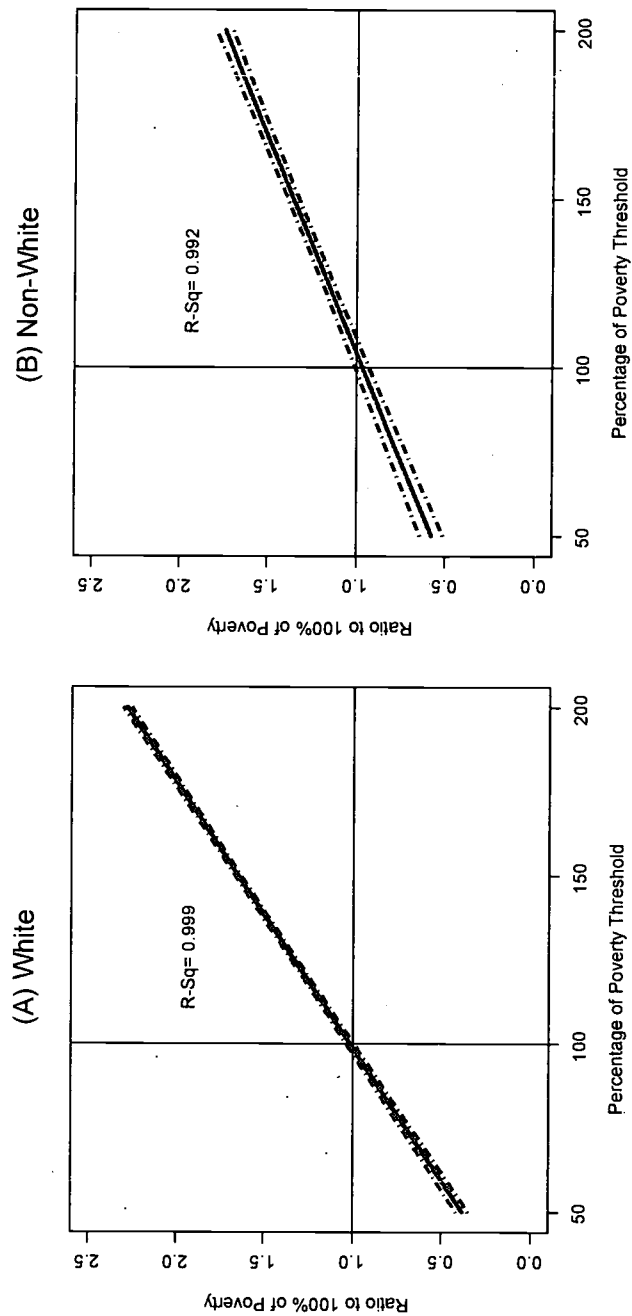
This shows the fitted linear regression lines to the ratios of various poverty thresholds to under 100% of poverty. The $R^2$ for the fits is extremely high, most likely due to the estimates of poverty ratios from the CPS being derived from a linear model

# Figure 6

## 95% Credible Intervals for the Proportion of Children Income-Eligible to Receive Medicaid Assistance in Allegheny County, Pennsylvania, July 1997
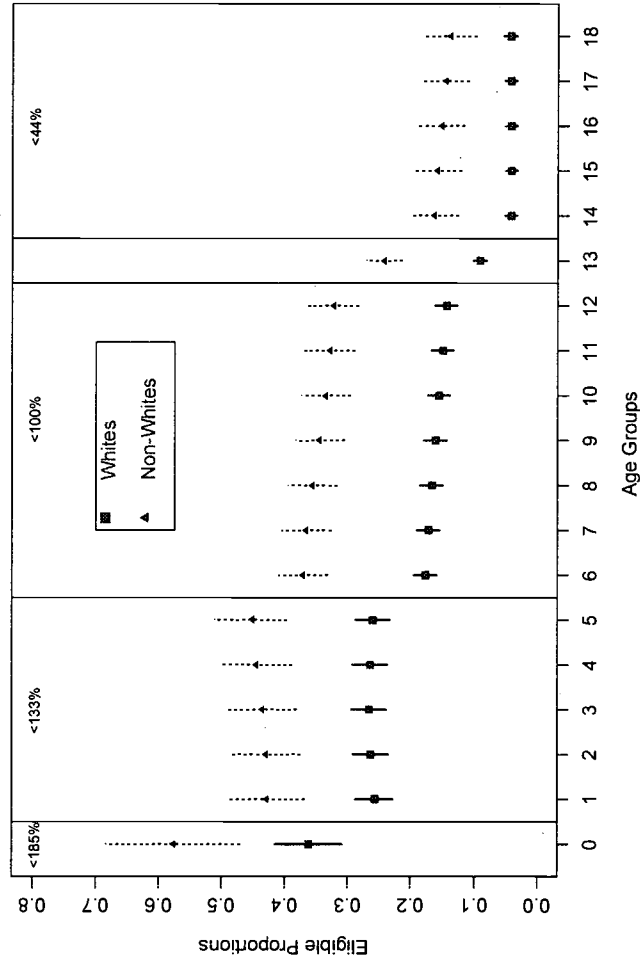


Separately for Whites and Non-Whites, the 95% credible intervals for the proportion of children income-eligible to receive Medicaid are shown, with the medians displayed as symbols, the lines extending for the width of the intervals.

31                                                                    32

## Figure 7
## 95% Credible Intervals for Medicaid Take-Up Rates in Allegheny County, Pennsylvania, July 1997
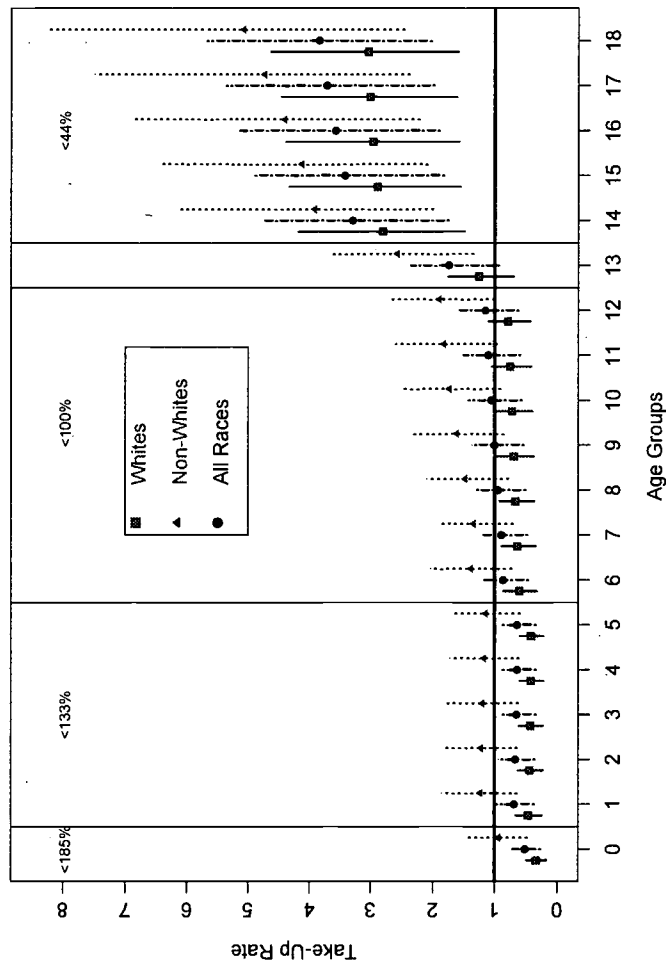


95% Credible Intervals for Medicaid Take-Up rates in Allegheny County, July 1997 are shown, with the medians displayed as symbols, and lines extending for the width of the intervals. Clearly shown is that among Whites under 13 years of age, fewer children than are eligible take advantage of Medicaid assistance. For Non-Whites between 1 and 13 years of age, it is likely that **more** children than are eligible are receiving Medicaid assistance. For all races, however, there are more children over 13 years of age receiving Medicaid assistance, based on income-eligibility criteria, than are thought to be eligible.

33                                                                                          34

# Figure 8
## Take-Up Rates by State

Legend:
- 0.6-0.8
- 0.8-1.0
- 1.0-1.2
- 1.2-1.4
- 1.4-1.6
- 1.6-1.8

State labels:

ME 1.1, NH 0.7, VT 1.03, MA 1.13, RI 0.47, CT 1.02, NJ 1.05, DE 1.35, NY 1.1, PA 1.35, MD 0.82, VA 1.01, NC 1.17, SD 1.2, WV 1.15, OH 1.25, KY 0.63, TN 1.66, GA 1.17, FL 1.06, MI 1, IN 1.1, IL 1.34, MS 1.73, AL 1.15, WI 1.15, IA 1.1, MO 1.18, AR 1, LA 1.13, MN 1.48, ND 0.66, SD 1, NE 1.34, KS 1, OK 0.99, TX 0.96, MT 0.87, WY 1.16, CO 0.98, NM 0.75, ID 0.87, UT 0.81, AZ 1.08, NV 0.76, WA 1, OR 1.15, CA 0.73, HI 1.08, AK 1.21

Table 1
Population of Allegheny County, PA by Age, Sex, and Race, July 1, 1990:
Fully Adjusted and the Net Difference Between the Fully and only MARS-Adjusted Populations

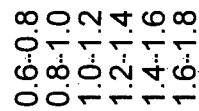| | Fully (MARS and Undercount) Adjusted Population | | | | | | | | | Net Difference Between Fully Adjusted and MARS Adjusted Populations | | | | | | | | |
| | Total | | | White | | Black | | Other | | Total | | | White | | Black | | Other | |
| Age | Both Sexes | Male | Female | Male | Female | Male | Female | Male | Female | Both Sexes | Male | Female | Male | Female | Male | Female | Male | Female |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| <5 | 86,907 | 44,362 | 42,545 | 35,810 | 34,234 | 7,949 | 7,733 | 603 | 578 | 2,018 | 998 | 1,020 | 340 | 374 | 638 | 629 | 20 | 17 |
| 5-9 | 81,252 | 41,487 | 39,765 | 34,100 | 32,661 | 6,792 | 6,543 | 596 | 561 | 1,779 | 904 | 875 | 317 | 318 | 570 | 538 | 18 | 19 |
| 10-14 | 75,012 | 38,221 | 36,791 | 31,314 | 30,026 | 6,340 | 6,209 | 567 | 555 | 1,603 | 809 | 794 | 257 | 259 | 538 | 520 | 14 | 14 |
| 15-19 | 82,726 | 41,796 | 40,929 | 34,215 | 33,335 | 6,834 | 6,982 | 748 | 612 | 1,688 | 825 | 862 | 220 | 247 | 588 | 601 | 18 | 14 |
| 20-24 | 94,519 | 46,610 | 47,909 | 39,708 | 40,500 | 5,920 | 6,711 | 983 | 698 | 1,279 | 733 | 546 | 259 | 45 | 418 | 488 | 57 | 13 |
| 25-29 | 105,208 | 51,361 | 53,846 | 44,736 | 45,846 | 5,661 | 7,141 | 964 | 860 | 1,502 | 1,035 | 466 | 586 | (11) | 345 | 460 | 104 | 18 |
| 30-34 | 116,710 | 57,146 | 59,564 | 50,292 | 51,343 | 5,832 | 7,437 | 1,022 | 784 | 1,215 | 903 | 312 | 440 | (203) | 360 | 502 | 103 | 13 |
| 35-39 | 107,318 | 52,293 | 55,026 | 46,495 | 47,592 | 5,126 | 6,723 | 672 | 710 | 1,119 | 438 | 682 | 227 | 268 | 205 | 396 | 6 | 17 |
| 40-44 | 92,240 | 44,226 | 48,013 | 39,337 | 41,952 | 4,347 | 5,454 | 542 | 608 | 593 | 183 | 409 | 42 | 113 | 142 | 288 | (1) | 9 |
| 45-49 | 71,282 | 33,236 | 38,045 | 29,788 | 33,415 | 2,974 | 4,164 | 474 | 467 | -297 | 48 | 248 | (33) | 40 | 84 | 204 | (3) | 5 |
| 50-54 | 63,052 | 28,986 | 34,067 | 26,045 | 30,049 | 2,582 | 3,714 | 359 | 303 | 183 | 7 | 177 | (54) | 5 | 64 | 169 | (3) | 2 |
| 55-59 | 63,232 | 29,247 | 33,985 | 26,508 | 30,399 | 2,527 | 3,389 | 212 | 198 | (1,067) | (330) | (737) | (241) | (664) | (89) | (65) | 0 | (7) |
| 60-64 | 75,521 | 34,514 | 41,006 | 31,670 | 37,012 | 2,694 | 3,817 | 150 | 176 | (1,337) | (422) | (916) | (321) | (830) | (101) | (81) | (0) | (6) |
| 65-69 | 73,504 | 32,055 | 41,449 | 29,496 | 37,978 | 2,446 | 3,357 | 112 | 115 | (1,359) | (423) | (936) | (330) | (854) | (94) | (77) | 0 | (4) |
| 70-74 | 61,060 | 24,876 | 36,184 | 23,163 | 33,429 | 1,651 | 2,668 | 62 | 87 | (1,144) | (318) | (826) | (255) | (760) | (63) | (63) | (0) | (3) |
| 75-79 | 45,571 | 16,899 | 28,673 | 15,690 | 26,498 | 1,166 | 2,122 | 43 | 52 | (840) | (192) | (647) | (144) | (605) | (48) | (42) | (0) | (1) |
| 80-84 | 27,332 | 8,882 | 18,450 | 8,167 | 17,109 | 693 | 1,304 | 22 | 36 | (499) | (75) | (424) | (52) | (398) | (23) | (25) | (0) | (2) |
| 85+ | 20,129 | 5,366 | 14,763 | 4,821 | 13,578 | 522 | 1,162 | 23 | 23 | (319) | (34) | (285) | (15) | (264) | (19) | (20) | 0 | (1) |
| Total | 1,342,576 | 631,565 | 711,011 | 551,356 | 616,957 | 72,056 | 86,630 | 8,153 | 7,424 | 6,712 | 5,091 | 1,621 | 1,244 | (2,919) | 3,515 | 4,422 | 332 | 118 |
| Pop. <20 | 325,897 | 165,866 | 160,030 | 135,439 | 130,257 | 27,915 | 27,466 | 2,513 | 2,307 | 7,088 | 3,536 | 3,551 | 1,134 | 1,199 | 2,334 | 2,287 | 69 | 65 |

Based on data obtained from the U.S. Census Bureau. Numbers in parentheses indicate that the fully adjusted population is less than the MARS- adjusted population.

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## Table 2
### Bayesian Estimated Population Below 19 Years of Age in Allegheny County, Pennsylvania by Race and Single Year of Age, July 1, 1997

| Age | White 5th Percentile | White Mean | White 95th Percentile | Non-White 5th Percentile | Non-White Mean | Non-White 95th Percentile |
|---|---|---|---|---|---|---|
| 0 | 11,843 | 13,058 | 15,489 | 3,108 | 3,471 | 3,766 |
| 1 | 12,130 | 13,374 | 15,863 | 3,127 | 3,492 | 3,789 |
| 2 | 12,416 | 13,690 | 16,239 | 3,148 | 3,516 | 3,815 |
| 3 | 12,703 | 14,003 | 16,610 | 3,170 | 3,539 | 3,841 |
| 4 | 12,975 | 14,306 | 16,969 | 3,187 | 3,561 | 3,863 |
| 5 | 13,233 | 14,586 | 17,298 | 3,205 | 3,579 | 3,885 |
| 6 | 13,458 | 14,836 | 17,607 | 3,207 | 3,588 | 3,895 |
| 7 | 14,210 | 14,215 | 14,219 | 3,742 | 3,746 | 3,750 |
| 8 | 14,054 | 14,057 | 14,060 | 3,494 | 3,498 | 3,501 |
| 9 | 13,953 | 13,958 | 13,961 | 3,307 | 3,310 | 3,312 |
| 10 | 13,884 | 13,887 | 13,890 | 3,171 | 3,173 | 3,176 |
| 11 | 13,817 | 13,822 | 13,824 | 3,073 | 3,076 | 3,079 |
| 12 | 13,732 | 13,735 | 13,738 | 3,001 | 3,004 | 3,008 |
| 13 | 13,599 | 13,602 | 13,606 | 2,944 | 2,947 | 2,949 |
| 14 | 13,401 | 13,404 | 13,406 | 2,891 | 2,893 | 2,896 |
| 15 | 13,125 | 13,128 | 13,132 | 2,831 | 2,834 | 2,837 |
| 16 | 12,787 | 12,791 | 12,795 | 2,765 | 2,768 | 2,771 |
| 17 | 12,440 | 12,445 | 12,449 | 2,706 | 2,708 | 2,711 |
| 18 | 12,163 | 12,168 | 12,173 | 2,665 | 2,667 | 2,671 |
| Total | 249,923 | 259,065 | 277,328 | 58,742 | 61,370 | 63,515 |

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**Table 3**

**Proportion of Children < 18 Years of Age Below Various Poverty Levels, 1997**

| 1997 Poverty Level | All Races | White | Nonwhite |
|---|---|---|---|
| < 50% | 9% | 7% | 18% |
| <100% | 20% | 16% | 34% |
| <125% | 25% | 21% | 41% |
| <150% | 31% | 26% | 46% |
| <175% | 36% | 32% | 52% |
| <185% | 38% | 34% | 55% |
| <200% | 41% | 37% | 58% |

US Census Bureau 1998 Current Population Survey Table 22.
http://ferret.bls.census.gov/macro/031997/pov/22_000.htm.

## Table 4
## Assumptions Regarding the Income Distribution of Children as it Relates to Medicaid Eligibility by Age and Race

| | Proportion of U.S. Children below 100% of Poverty, 1997 | | Medicaid Income Eligibility Threshold, 1997 (% of poverty level) | The proportion of children that fall below the 1997 Medicaid income-eligibility threshold (mean and 5th and 95th percentiles of credible interval) | | | | | |
| | | | | White | | | Non-White | | |
| Age | White | Black | | 5th Percentile | Mean | 95th Percentile | 5th Percentile | Mean | 95th Percentile |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 15.8% | 39.2% | 185% | 31.8% | 36.1% | 40.7% | 48.8% | 57.6% | 66.4% |
| 1 | 18.7% | 30.0% | 133% | 23.3% | 25.7% | 28.2% | 37.7% | 42.9% | 48.2% |
| 2 | 19.0% | 35.3% | 133% | 24.1% | 26.4% | 28.7% | 38.3% | 43.1% | 47.8% |
| 3 | 19.7% | 33.7% | 133% | 24.3% | 26.6% | 28.9% | 38.9% | 43.6% | 48.4% |
| 4 | 17.8% | 36.5% | 133% | 24.2% | 26.5% | 28.8% | 39.7% | 44.5% | 49.4% |
| 5 | 19.3% | 38.3% | 133% | 23.8% | 26.0% | 28.3% | 40.6% | 45.2% | 50.1% |
| 6 | 15.5% | 39.3% | 100% | 16.2% | 17.7% | 19.2% | 33.8% | 37.1% | 40.3% |
| 7 | 18.1% | 38.5% | 100% | 15.8% | 17.2% | 18.7% | 33.4% | 36.6% | 39.8% |
| 8 | 16.9% | 36.9% | 100% | 15.3% | 16.7% | 18.2% | 32.3% | 35.6% | 38.9% |
| 9 | 16.3% | 30.3% | 100% | 14.7% | 16.2% | 17.6% | 31.2% | 34.4% | 37.6% |
| 10 | 14.6% | 31.8% | 100% | 14.2% | 15.6% | 17.0% | 30.3% | 33.5% | 36.7% |
| 11 | 17.0% | 32.9% | 100% | 13.6% | 15.0% | 16.5% | 29.6% | 32.9% | 36.1% |
| 12 | 13.6% | 34.4% | 100% | 13.1% | 14.4% | 15.9% | 29.0% | 32.3% | 35.6% |
| 13 | 13.2% | 29.7% | 100% / 44% | 8.3% | 9.1% | 10.0% | 21.9% | 24.2% | 26.6% |
| 14 | 14.3% | 31.1% | 44% | 3.5% | 4.2% | 5.0% | 13.3% | 16.4% | 19.7% |
| 15 | 12.9% | 35.6% | 44% | 3.4% | 4.2% | 5.0% | 12.8% | 15.9% | 19.1% |
| 16 | 13.8% | 23.7% | 44% | 3.4% | 4.2% | 5.0% | 12.3% | 15.2% | 18.4% |
| 17 | 13.4% | 28.8% | 44% | 3.5% | 4.2% | 5.1% | 11.6% | 14.5% | 17.7% |
| 18 | 14.6% | 33.7% | 44% | 3.4% | 4.3% | 5.2% | 10.4% | 13.9% | 17.5% |

The 5th and 95th percentiles reflect the lower and upper bounds of our estimate of the population. The range presented is that of a 90% credible interval. In 1997, the Medicaid eligibility criteria were for age 0, <185% of the poverty level; for ages 1-5, 133% of the poverty level; for ages 6-13.5, 100% of the poverty level; and for age 13.5 through 18 years, 44% of the poverty level. Based on statistics provided by the US Census Bureau, 1997 Current Population Survey Table 23 http://ferret.bls.census.gov/macro/031998/pov/new23_001.htm.

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## Table 5
## Bayesian Estimated Number of Children Eligible for Medicaid in
## Allegheny County, Pennsylvania by Age and Race, July 1, 1997

|  | White | | | Non-White | | |
|---|---|---|---|---|---|---|
| Age | 5th Percentile | Mean | 95th Percentile | 5th Percentile | Mean | 95th Percentile |
| 0 | 3,980 | 4,719 | 5,737 | 1,650 | 1,998 | 2,365 |
| 1 | 2,979 | 3,436 | 4,155 | 1,276 | 1,498 | 1,729 |
| 2 | 3,138 | 3,606 | 4,354 | 1,299 | 1,513 | 1,730 |
| 3 | 3,241 | 3,726 | 4,496 | 1,327 | 1,544 | 1,762 |
| 4 | 3,298 | 3,784 | 4,555 | 1,365 | 1,585 | 1,811 |
| 5 | 3,305 | 3,793 | 4,568 | 1,395 | 1,618 | 1,844 |
| 6 | 2,295 | 2,626 | 3,170 | 1,159 | 1,330 | 1,496 |
| 7 | 2,247 | 2,450 | 2,661 | 1,250 | 1,370 | 1,491 |
| 8 | 2,148 | 2,350 | 2,557 | 1,131 | 1,244 | 1,359 |
| 9 | 2,056 | 2,256 | 2,461 | 1,032 | 1,138 | 1,245 |
| 10 | 1,967 | 2,164 | 2,365 | 962 | 1,063 | 1,166 |
| 11 | 1,883 | 2,076 | 2,274 | 912 | 1,010 | 1,111 |
| 12 | 1,794 | 1,984 | 2,183 | 872 | 970 | 1,068 |
| 13 | 1,129 | 1,243 | 1,361 | 646 | 714 | 784 |
| 14 | 465 | 563 | 670 | 384 | 475 | 570 |
| 15 | 451 | 547 | 650 | 364 | 451 | 541 |
| 16 | 439 | 534 | 636 | 340 | 421 | 508 |
| 17 | 432 | 526 | 628 | 313 | 394 | 479 |
| 18 | 417 | 523 | 638 | 278 | 370 | 468 |

In 1997, the Medicaid eligibility criteria were for age 0, <185% of the poverty level; for ages 1-5, 133% of the poverty level; for ages 6-13.5, 100% of the poverty level; and for age 13.5 through 18 years, 44% of the poverty level.

## Table 6
## Age and Race Distribution of Medicaid Cases in Allegheny County, Pennsylvania, August 1997 (Actual) and July 1997 (Estimated)

| | Actual Income-Eligible Medicaid Recipients, August 1997 | | | Estimated Income-Eligible Medicaid Recipients, July 1997 | | |
|---|---|---|---|---|---|---|
| Age | Total | White | Non-White | Total | White | Non-White |
| 0 | 3,383 | 1,709 | 1,674 | 3,147 | 1,590 | 1,557 |
| 1 | 4,441 | 2,144 | 2,297 | 4,118 | 1,988 | 2,130 |
| 2 | 4,308 | 2,033 | 2,275 | 3,979 | 1,878 | 2,101 |
| 3 | 4,382 | 2,020 | 2,362 | 4,037 | 1,861 | 2,176 |
| 4 | 4,519 | 2,001 | 2,518 | 4,162 | 1,843 | 2,319 |
| 5 | 4,441 | 1,918 | 2,523 | 4,083 | 1,764 | 2,320 |
| 6 | 4,359 | 1,895 | 2,464 | 4,011 | 1,744 | 2,268 |
| 7 | 4,208 | 1,828 | 2,380 | 3,869 | 1,681 | 2,188 |
| 8 | 3,978 | 1,743 | 2,235 | 3,645 | 1,597 | 2,048 |
| 9 | 3,736 | 1,713 | 2,023 | 3,420 | 1,568 | 1,852 |
| 10 | 3,520 | 1,586 | 1,934 | 3,218 | 1,450 | 1,768 |
| 11 | 3,279 | 1,517 | 1,762 | 2,992 | 1,384 | 1,608 |
| 12 | 3,081 | 1,488 | 1,593 | 2,808 | 1,356 | 1,452 |
| 13 | 2,708 | 1,310 | 1,398 | 2,456 | 1,188 | 1,268 |
| 14 | 2,526 | 1,185 | 1,341 | 2,265 | 1,063 | 1,203 |
| 15 | 2,430 | 1,138 | 1,292 | 2,170 | 1,016 | 1,154 |
| 16 | 2,260 | 1,048 | 1,212 | 2,018 | 936 | 1,082 |
| 17 | 2,194 | 1,072 | 1,122 | 1,969 | 962 | 1,007 |
| 18 | 1,872 | 877 | 995 | 1,699 | 796 | 903 |
| Total <19 | 65,625 | 30,225 | 35,400 | 60,069 | 27,665 | 32,404 |

Based on Department of Public Welfare, personal communication (Joe Mancuso), 12/9/97, and data found in worktables from the Pennsylvania Department of Public Welfare, Client Information System, 1997 and 1998. The "White" category includes persons categorized either as white or Hispanic. The remainder are considered "Nonwhite." In 1997, the Medicaid eligibility criteria were for age 0, <185% of the poverty level; for ages 1-5, 133% of the poverty level; for ages 6-13.5, 100% of the poverty level; and for age 13.5 through 18 years, 44% of the poverty level. The number of MA recipients presented above excludes children receiving MA because of a disability who are not income-eligible for MA and hence, would not have otherwise received it. The number of MA recipients also excludes "medically needy only" children (MNOs) who are eligible for MA only when "spend-down" is considered. Without the spend-down, these children would not be income-eligible for MA. The Department of Public Welfare estimates that 5% of all child recipients receive MA because of spend-down (Moore, personal communication).

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## Table 7

## The Number of Children Enrolled in and Income-Eligible for the Medicaid Program Divided by the Number of Children Estimated to be Eligible for the Program by Age and Race, Allegheny County, Pennsylvania, July 1997

| Age | Eligibility Threshold (Percent of Poverty) | All Races | | | White | | | Non-White | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 5th Percentile | Mean | 95th Percentile | 5th Percentile | Mean | 95th Percentile | 5th Percentile | Mean | 95th Percentile |
| 0 | 185% | 0.30 | 0.52 | 0.72 | 0.19 | 0.34 | 0.47 | 0.55 | 1.00 | 1.46 |
| 1 | 133% | 0.40 | 0.71 | 0.97 | 0.27 | 0.46 | 0.64 | 0.73 | 1.32 | 1.90 |
| 2 | 133% | 0.39 | 0.68 | 0.93 | 0.25 | 0.44 | 0.61 | 0.73 | 1.31 | 1.87 |
| 3 | 133% | 0.38 | 0.66 | 0.91 | 0.25 | 0.42 | 0.59 | 0.71 | 1.28 | 1.82 |
| 4 | 133% | 0.37 | 0.65 | 0.89 | 0.24 | 0.42 | 0.58 | 0.69 | 1.25 | 1.78 |
| 5 | 133% | 0.37 | 0.64 | 0.88 | 0.24 | 0.42 | 0.58 | 0.68 | 1.22 | 1.74 |
| 6 | 100% | 0.50 | 0.88 | 1.20 | 0.35 | 0.60 | 0.83 | 0.83 | 1.48 | 2.09 |
| 7 | 100% | 0.57 | 0.99 | 1.32 | 0.41 | 0.69 | 0.92 | 0.90 | 1.59 | 2.21 |
| 8 | 100% | 0.56 | 0.97 | 1.30 | 0.40 | 0.67 | 0.90 | 0.90 | 1.60 | 2.23 |
| 9 | 100% | 0.58 | 1.00 | 1.34 | 0.40 | 0.68 | 0.91 | 0.95 | 1.69 | 2.35 |
| 10 | 100% | 0.60 | 1.05 | 1.40 | 0.42 | 0.71 | 0.95 | 1.01 | 1.80 | 2.51 |
| 11 | 100% | 0.64 | 1.11 | 1.48 | 0.44 | 0.74 | 1.00 | 1.07 | 1.91 | 2.67 |
| 12 | 100% | 0.68 | 1.17 | 1.56 | 0.46 | 0.78 | 1.05 | 1.14 | 2.03 | 2.83 |
| 13 | 100%/44% | 1.04 | 1.79 | 2.39 | 0.75 | 1.26 | 1.70 | 1.57 | 2.80 | 3.90 |
| 14 | 44% | 1.98 | 3.43 | 4.77 | 1.62 | 2.82 | 3.97 | 2.33 | 4.29 | 6.30 |
| 15 | 44% | 2.06 | 3.57 | 4.96 | 1.68 | 2.90 | 4.10 | 2.47 | 4.51 | 6.66 |
| 16 | 44% | 2.11 | 3.70 | 5.16 | 1.71 | 2.96 | 4.18 | 2.60 | 4.80 | 7.12 |
| 17 | 44% | 2.20 | 3.85 | 5.36 | 1.74 | 3.01 | 4.28 | 2.79 | 5.15 | 7.66 |
| 18 | 44% | 2.27 | 3.97 | 5.62 | 1.74 | 3.03 | 4.35 | 2.94 | 5.52 | 8.47 |

Numbers that exceed 1 (italicized) are outside of the theoretical range of a take-up rate. In these cases, the number of people enrolled in the program exceeds the number of people thought to be eligible for the program. See text for discussion.

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